Abstract

Perceived as one of the most significant cultural markers of the Austronesian movements into the Pacific, Lapita pottery appeared in the Bismarck Archipelago of Papua New Guinea some 3500 years ago with highly complex decorative motifs and vessel forms. Pacific archaeologists have been using various statistical means to search for patterns that may infer migration routes/directions by comparing different frequencies of certain design elements and motifs, as well as motif constructing rules, over time and space. How these highly dedicated decorative styles and pottery-making techniques had been shared or transformed from one island to another, and how many of these styles had continued to be practices for more than several hundreds of years, are the most intriguing questions that will broaden our understanding of the past. However, due to the limitations of previous coding systems and the lack of a fast and reliable communication platform, comparison of complex vessel forms and motifs amongst various island groups have been severely crippled over the past few decades.

After five years of designing and testing, the beta version of an online database built for enhancing the research possibilities of Lapita pottery is now being offered to the public. In this paper I will present the newly developed online Lapita pottery database and its applications for future research topics. There are four major functions that will enable those who participate in this database to perform a much more detailed analysis: 1) its combination of data and GIS system enables one to view the results spatially; 2) a complex motif/vessel form search engine that allows one to search a given sequence of motifs on any specific vessel form; 3) a comprehensive recording scheme that stores a lot of attribute information for a given sherd; 4) a simply online statistical calculation that allows one to gain a quick assess for any trend of change. Potsherd information of an early Lapita site, Kamgot, Anir Islands, Papua New Guinea, will be used as an example to demonstrate the functions of this database in this paper.
Introduction

This paper aims to illustrate the design and major functions of the Internet-based database for the study of Lapita pottery (http://lapita.rchss.sinica.edu.tw) (Figure 1). Established mainly to help researchers across the world to study the complex motif and vessel forms of Lapita pottery that appears in seven countries in the Pacific, this database has the capacity to integrate morphological, compositional, stylistic, and geological attributes of Lapita pottery, making either searching a particular attribute or recording an attribute of any piece of Lapita pottery online an easy task for all. In addition, through the combination of digital data and the GIS in Google Map format, end users may freely select single or multiple countries, island groups, or even down to the site-specific units, to learn about the spatial distribution of Lapita potsherds on different scales. Currently the beta version of this database includes digitalized data of Lapita potsherds from several important Lapita sites in Papua New Guinea, the Solomon Islands, and New Caledonia, while Lapita pottery excavated from Vanuatu, Fiji, Tonga and Samoa Lapita sites will be digitalized and included into the database in the coming years.

Judging by the numerous shared characteristics such as subsistence practices, artifact morphologies, and site location preferences, it has long been proposed that these people present "some early community of culture" for the Southwest Pacific (Golson 1961: 176), indicating a “early cultural continuum” (Golson 1971: 67) spreading from eastern Melanesia to Polynesia. This cultural continuum was further strengthened by various parallel ethnographic examples of Polynesian bark cloth and tattoo designs (Green 1979a), and have been referred as the one of the most fundamental assumptions for regional and temporal occurrence and frequency seriation for both Lapita motifs and vessel forms.

Yet during the past few decades, numerous attempts to generate a reliable systematic recording theme, with rapid and accurate description of Lapita pottery had experienced some major fallbacks. In the following section I will briefly describe what have been carried out for the study of Lapita motifs and vessel forms, and the problems encountered by these brave pioneers.

Previous methods for classifying Lapita motifs

The first attempt to establish a systematic classification scheme for recording Lapita motifs was conducted by Jack Golson back in the 1970s. By classifying Lapita motifs based on basic outlines of a design, named as “Rectangular meander and variations”, “Arcade”, “Y-motif”, “Curvilinear compositions”, “Rectangular composition”, and “’Shield’ motif”, Golson was then able to compare the occurrence of each of these motif categories amongst Watom of the Bismarck Archipelago of Papua New Guinea, New Caledonia, Tonga, with similar motifs found in Kalanay of the Philippines, and central Vanuatu (Golson 1972: 558-9). The next major attempt was made by Jens Poulsen, who further developed a systematic scheme for recording ceramic materials excavated from 6 Lapita sites: the kinds of sherds containing decoration, decorating techniques, form of decoration, the position of decoration on the sherd, the recognition of zone markers, and the motif sequence in horizontal zones from lip to base. The very last two concepts were inherited by Hirini Mead in his
Applying linguistic concepts of using phonemes and morphemes to construct smallest meaningful units as sounds, words, and sentences, Mead aimed to provide “a structural approach in which an attempt is made to reveal the steps and rules by which patterns were constructed” instead of a mere listing of design elements and motifs in his study of Fijian Lapita sherds. He thus started from recognizing techniques used to create the Lapita design elements, a list of design elements and motifs, and a set of rules governing the sequence of motifs on various parts of vessels (Mead 1975a: 20). Mead then applied these motif construction rules to the Tongan materials Poulsen had analyzed, and found no new design element other than the ones recognized from his Fijian materials, and the position and construction rules of motifs on a pot does not change at all. He then added on materials collected from Site 13A and Vatcha of New Caledonia, Watom of Papua New Guinea, and Malo of Vanuatu to his analysis, and received a similar result. Thus it was argued that the Lapita decorative system were employed in a vast region, while the underlying motif construction rules and design elements rarely altered, indicating a cultural system shared and maintained by numerous Lapita communities.

Lorna Donovan (Donovan 1973) took on the task to expand Mead’s motif classification system with ceramic assemblages acquired from the Reef/Santa Cruz Lapita sites by Roger Green in the 1970s, while Minh Parker (Parker 1981) investigated possible vessel forms of the same assemblages, and the relationship between vessel form to design fields, and was able to identify the distribution of certain motifs on different parts of vessels of various shapes. Others had also added new data into the inventory over the years, resulting in more than 122 categories of motifs and their alloforms. With these data at hand, Green was able to conduct statistical procedures, demonstrating that there is a highly similar inventory of motifs shared by a wide range of regions early on in Lapita era, local variations would then gradually took place, and there is a distinguish change from West to East, from early to late Lapita era (Green 1978, 1979b).

The last attempt of investigating the motif construction rules was carried out by Nancy Sharp in the late 1980s (Sharp 1988). She reasoned that by understanding what rules were used to select certain design elements to create a motif, archaeologists will then be able to identify easily what criteria constitute a motif and its alloforms, and be able to illustrate the trend of modifications of a particular motif in any given region. She was able to write up 389 motif construction rules, and identified that 24 of them were shared by the Fijian and Solomon Lapita potters. Another major finding of her study is that with more design elements and construction rules available at hand, Lapita potters from the west generally produced visually more complex motifs than potters of the east, even with similar motif construction rules (Sharp 1988: 79-81).

In sum, this type of motif construction approach is able to help researchers to identify the basic structure of a given motif, the subtle changes in the selection of design elements while keeping the motif highly similar to its alloforms. It is from this approach that one may systematically investigate the relationship between art forms and social network of ancient potters. Both frequency and occurrence seriations may also be employed to help determine the relative chronology of ill-dated sites back in
the era where radiocarbon dating was not yet well-developed (Donovan 1973). However, both Poulsen’s and Mead’s approaches were criticized by others as being too subjective and arbitrary, as none of them listed clearly what criteria had been used to generate motif categories, nor the rules of assigning alloforms to the existing motifs. Statistical results generated by these predetermined subjective rules are thus rather misleading in terms of understanding ancient minds (Specht 1977). Although Sharp did modify the original definition of Fijian Lapita design elements of Mead to better describe the more complex motifs she was handling from the Reef/Santa Cruz, the fact that she kept the number of design element at 25 inevitably resulting in a much complex set of motif construction rules, which generates a lot of errors (Chiu 2003).

Working on materials collected from Far Western Lapita Province where the most naturalistic and complex motifs are abundant, Anson found the construction rules generated by Mead and Sharp were simply incapable to handle the data. Being conscious about what constitutes a culturally meaningful motif or not based on fragmented sherds, he argued that by ignoring even just the number of lines included in a triangle motif as Mead would do, will result in the failure of recognizing existing systematic local variations that may separate Watom from those of the Ambitle, Talasea, and Elouau sites. Anson thus took on a different approach to record Lapita motifs by listing out all decorative units that is not identical to an existing one, and resulted in a list of 527 motifs over the years (Anson 1983, 1986, 1990, 2000). As adding new motifs onto Anson’s list is a much easier task than trying to allocate them according to the subjective rules recognized by Mead and Sharp, most Lapita pottery assemblages were recorded using this method for the past 20 years.

In 1990, Siorat proposed another classification scheme, separating first the major central motifs (major bands) which cover the largest area of a decorated pot from the associated zone markers (supplementary friezes), followed by motif categories once again established based on the tools used (such as Linear, Curved, and Composite tools) and the overall geometric shape of a given motif (such as vertical, chequered, diagonal, oblique, zigzag, etc.), allocating central motifs and zone markers into different themes. Using visual impression instead of underlying motif construction rules to classify motifs, he argues, may avoid the problems of equating grammar errors caused by subjective judgments of researchers to basic structural variations that really existed in the minds of Lapita potters, yet at the same time providing some evidence for visual organization of shapes. His approach is employed and further developed by Sand and Noury in the recent years, in their attempts to classify and study Lapita pottery from sites of New Caledonia and Vanuatu (Sand 1996; Noury 1998, 2000; Bedford et al. 2004).

Therefore, when I took on the job to design the online Lapita database, there were several important issues that most Pacific archaeologists agreed that this database should address: 1) it should be capable of providing rapid and accurate updates of newly round motifs and vessel forms, and available online for all to access; 2) it should be capable of providing standardized recording codes to allow future comparisons, and both morphological and decorative attributes should be presented graphically to avoid confusion; 3) it should be capable of linking motifs to different design zones on the surface of a given vessel, and be able to keep the sequence of motifs as a whole for future comparison; 4) it should contain GIS information and
show the distribution of attributes spatially for a quick visual inspection online; and lastly, 5) it should contain a simple statistic means to generate frequency tables for certain attributes, providing a tool for quick intra-site comparison.

**The motif and vessel form classification scheme**

As geometric motifs can be classified rather easily by looking at the symmetry of design elements in a horizontal zone, those naturalistic ones cannot be analyzed as such. Yet just like Mead, Donovan, and Sharp, Siorat, Sand, Noury, and I also faced the problems of decoding complex central motifs. As later in the Lapita sequence simple friezes will take up the space of the central bands and become the main decorations on a pot (Best 2002; Mead 1975b), Sand and I also stress the importance of distinguishing the friezes from the central bands, not by subjective judgment of how complex a motif look like, but where does it appear on a pot (Chiu and Sand 2005: 139). A more detailed description and modification of Sand’s original method on 15 New Caledonia Lapita motif themes was discussed in a previous paper by Chiu and Sand, where we proposed that

“the more applicable methodology at this stage is to adopt an approach that not only separates the recording of the supplementary friezes from the central bands, but also analyzes them differently. Thus, the basic concepts of classifying motifs according to the tools used to execute them, of treating friezes differently from central bands (Siorat 1990), of describing the ways different tools were combined to create images (Donovan 1973; Mead 1975; Sharp 1988), and of stressing the importance of the moving direction of a design element in the decoration (Anson 1986) are all combined and integrated in this new program” (Chiu and Sand 2005: 135).

Each of these 15 motif themes were further deconstructed in our attempt to illustrate how we may record the underlying structure rules for the more complex motifs, while at the same time trying desperately not to dissect a particular motif into endless number of design elements, nor forcing our own logic to write up grammars that will not be able to correctly reproduce a given motif (Chiu and Sand 2005: 143-7).

In the following 5 years, Sand, Summerhayes, and I have all worked occasionally together to come up with a logical sequence of deconstructing Lapita motifs, creating a tree structure for others to follow (Figure 2). First one needs to decide whether the motif is a geometric one or a more naturalistic one, the tool used to execute the motif, whether it is constructed by one single or multiple design elements. For the non-geometric motifs, a more visual approach is used to dissect, say, a face motif, into several “essential” parts (i.e., what most archaeologists nowadays used for assigning fragmented motifs into the face motif category), and record them accordingly. By taking such a visual approach one may avoid the mistakes that Sharp had done – creating false grammars from fragmented materials.

For searching or coding the geometric motifs, one will find himself/herself in the midst of sequential steps of determining symmetry rules such as how those elements are organized horizontally, how many times do they repeat themselves vertically,
whether these design elements or units show a continuous transformation. It was our hope that by tracking down the series of steps one uses to reproduce or deconstruct a motif, will leave a clear record of how the underlying construction rules of a motif look like, and this record will enable us to conduct further comparisons on the mental templates or prototypes of major motif categories.

Zone markers are treated differently. The ones made of one or two straight lines that are just marking the edge of a motif are ignored in the coding, as what most people will be looking for in a database is the motif itself, not how it had been outlined. Once a researcher locates the motif, he/she will have the option to select the one with either linked zone markers or discontinued ones to keep the record straight. The more complex ones are either treated individually as simple geometric motifs, or as an add-on independent category if they appear in naturalistic motifs.

In order to examine the position of a motif on any vessel form, I also dissect a given vessel into morphological dimensions such as lip, rim, neck, carination, body, and base. A total number of 43 design zones were thus illustrated in the database. Inspired by Rice (Rice 1987: 215) and Roe (Roe 1995: Fig.2-3, p. 36-7), I have done the same kind of float chart for Lapita vessel forms (Figure 3), in the effort to establish a standard method of determining vessel types, and to record the underlying “prototypes” governing the shapes of various bowls, jars, carinated pots, and cylinder stands across the whole Lapita region.

Maintaining the flexibility

In the process of explaining the float chart for deconstructing motifs, such as the process graphically presented in Figure 2, to the software engineers, I was asked whether I want to present the series of deconstruction steps, training the users to get familiar with the underlying logic that several of us have come up with. What is essential in doing so, is to be able to achieve what Mead and Sharp had done: recording the minimal units and rules that govern the creation and modification of motifs for comparing “grammars” spatially and temporarily. Yet it was quickly realized that even with geometric motifs which can be described in clear symmetry rules, different researchers will certain come up with different steps for dissecting the same motif, let alone the more naturalistic ones. What we have deemed “logical” inevitably still contain subjective judgments at some level. If the user cannot follow our logic in a single step, they may not be able to track down the motifs they want to check.

In order to solve this problem, I then discussed with the software engineers and decided that we should bring even more flexibility to the database system by allowing each user to freely pick whatever attributes deemed necessary all at once when he/she searches the database. No more series of steps to go through, no more float charts.

Yet this means a standardized float chart for each and every motif that is known to this date needs to be created. In it every possible attributes (such as decorative techniques, design elements, infillings, appliqués, basic direction of transformation, structure, number of successive rows, etc.) that may be used by a researcher to search
for any particular motif will have to be defined and coded. A step by step manual is also needed for training new students to code new motifs in accordance with the old ones later in the future. So far, there are more than 2498 motifs (2D motifs) and appliqués (3D motifs) collected from published papers and unpublished thesis and field notes have already been coded, with 970 fragmented ones that can only be partially coded.

Starting from the standardization of maps and various coding themes provided by different cooperating scholars, digitalization of text, photos, graphs, collecting published and unpublished site reports, followed by numerous rounds of modification of the database design, to this date, there are more than 60 integrated recording themes and definition charts in this database, covering information such as site location, excavation history, stratigraphy, morphological attributes, measurements, petrographic and chemical compositional data, motif attributes, and literature references related to Lapita pottery assemblages. Since most researchers are highly interested in viewing motif occurrence and frequency spatially, the site location attributes, the search results and statistical summary of attribute frequencies have all been combined with GIS Google Maps on different scales, to provide a rapid visual aid.

With an add-on software, a research can easily download the recording scheme in a single excel sheet, with the visual aid provided online, to record the Lapita pottery at hand. He/she may then upload the entire sheet online back to this database. After being verified, any new motifs or morphological forms will be added and updated rapidly. Visual inspection of spatial distribution can be conducted with the online Google map, while further comparisons among various assemblages can be conducted either with the online statistic tool or in the downloaded excel sheet.

What this database has achieved, is not only to provide standardized recording scheme for further intra-site comparison on various characteristics, but also to maintain the flexibility for archaeologists to create suitable analytical types according to the purpose of their research questions.

**Functions of the online database for the study of Lapita pottery**

*How to conduct a search*

A researcher may start his/her search from geological location of site(s), either by selecting predefined regions, or by click-and-drop sites directly on the Google Map. Once the sites are selected, the user may further refine the search result by adding on various attributes provided in the Advanced Search (“adv.”) Pages. In these pages, attributes such as spatial context, morphological, compositional and technical, and decorative ones may be selected. Range of chronological dates, stratigraphic levels, and measurements can also be turned into search criteria.

Both vessel form and motif searches have been integrated into the “Database Search” section, each with its own set of attributes that may be used separately and correspondently. Within the “Vessel Form” search, 43 published vessels have been recoded and measured, each dissected into morphological parts, and then being
classified according to principles such as the ratio between height and width of a vessel suggested by Rice (Rice 1987: 215) into 27 Vessel Types (coded in X-0 format). Click on "Detail" of any vessel type, the user will see how a pot has been separated into different parts, and may search vessels with the same carination and lower body form while ignoring the lip and rim forms, to perform a vague search in the database for similar vessel types.

Motif search (Figure 4) is the most delicately designed part of this database, for it not only allows a researcher to conduct search of a motif by its common name (such as A100 or M28.3 that have been used by Pacific archaeologists over the past few decades), but also by its technical, morphological, and structural attributes. Once selected, a particular motif may be integrated into the design fields of a vessel form to conduct a search on sequences of motifs on the surface of a pot. Once the user is done with selecting motifs, click on "Back", and see if any other attributes are needed.

There are several ways of search motifs:

1. If the user wants to search a sequence of motifs on any vessel form, the user may drag up to 9 motifs down to the lower panel. If the user wants to search for the exact sequence of those motifs on a vessel, click "Order" to the right. If not, a vessel that contains all selected motifs, with different sequence of the motifs, will show up in the result page. For example, drag "A1", "A2", and "A3", and put them in this sequence in the lower panel, while leaving the other 6 fields blank. If the user then click on "Order" and search, only sherds contain this exact sequence of A1-A2-A3 from upper to lower part of a vessel will show up. If the user leaves the "Order" unchecked, sherds contain these three motifs, such as A1-A3-A2, A3-A2-A1, and A1-A2-A3, will all show up in the result.

2. If the user drag the "NA" (acts like a wild card) or the "Void" (the blank space in between motifs, acts as a single motif in the search) and put them into the sequence, they will help the user to search even more variety of motif sequences.

3. If the user wants to restrict the search to a certain type of vessel, these may be found within the “Vessel List”. For example, pick VF 48-1 and click on "Confirm". The user will see the selected vessel now showing up in the upper right corner, with all possible regions of decoration listed in the graph. The user may search up to 5 different motifs within each of these regions. Different vessels have different region numbers defined in the database, so make sure the user drag the motif image to the correct region.

4. The user will have several choices from now on.

A. The user may perform an Exact Search:
Simply pull the motifs from the Motif List onto the Regions in the sequence the user wants to search.
For example:
1=Lip: A445
3= Rim: M76-1-2
9= Upper Main Body: N31
Then only sherds that are classified as Vessel Form 48-1, and contain motifs A445 on the lip, M76-1-2 on the rim, and N31 on the upper main body will show up. If a sherd contains any other motif on it, it will not appear in the result page.

**B. The user may perform the following Vague Searches**

1) Click on "NA" right under the image of the vessel. This will allow the Search engine to freely include non-selected motifs in any blank fields the user left on the Region panels.  
   For example:
   1=Lip: A445, NA, NA, NA, NA  
   3= Rim: M76-1-2, NA, NA, NA, NA  
   9= Upper Main Body: N31, NA, NA, NA, NA
   Then sherds that are classified as Vessel Form 48-1, and have motifs A449, plus any other motifs on the lip, M76-1-2 plus any other motifs on the rim, and N31 plus any other motifs on the upper main body will show up.

2) Click on "R" (Random sequence) right under the Region Number. This will allow the Search engine to search selected motifs, within that particular Region, without considering the sequence of these motifs.  
   For example:
   R 1=Lip: A445  
   3= Rim: M76-1-2  
   10= Upper Carination: A35 and No.27
   Then only sherds that are classified as Vessel Form 48-1, and have motifs A445 on the lip, M76-1-2 on the rim, and A35 and No.27 on the upper carination will show up.
   Therefore with the function of "NA" and "R" added to the search, the user may perform all sorts of search on any type of vessel, with or without considering the sequence of motifs on the surface of a pot.

**The Search results**

The frequency and percentage of the selected attribute(s) from each of the site selected will be presented in the “Statistics” section of this page, while detailed information of each selected sherds may be found in “Complete Data” section. On the upper "Condition List" panel, the user will see the attributes used to search this particular sherd. Again, search results may be further filtered by de-selecting or re-selecting sites of interest from the resulting group of sherds. This feature is most useful when the number of sherds is too large to be handled. Registered Cooperating Researchers will be able to download their search results into excel files.

**Future developments of the Lapita database**

Frankly, without modern day computer technology and software capable of
processing images, geo-referenced data, and quantitative dataset simultaneously, without the accessibility provided by internet, it is nearly impossible for me to break through the predefined series of analytical steps outlined by previous scholars, and bring out this database that render great flexibilities in generating archaeological types for further investigations.

In the coming years there are several important tasks still wait ahead of this team. First of all, as we have only finished coding the motifs and design zones of Kamgot, materials from several other important Lapita sites need to be processed. So far Lapita pottery assemblages of Reef/Santa Cruz Islands of the Solomon Islands, several sites from New Ireland and Mussau Islands of Papua New Guinea, and six different Lapita sites in New Caledonia, plus two very important Lapita sites, Teouma and Vao, of Vanuatu, all need to be properly normalized and updated into the database. These cooperating projects have enabled this database to accommodate materials from most a lot of important Lapita sites, and surely will ensure a much clear comparison once these data have been processed.

Secondly, floor plans and stratigraphy of each of these sites need to be digitalized and processed as well, in order to provide detail contexts for sherds being examined. Once this is done, ArcGIS may be applied to conduct spatial analysis and cluster analysis of different attributes as well. And thirdly, and a much anticipated future development of this database, is to combine temporal attributes with the GIS, to present both spatial and temporal changes at the same time, as a visual tool for researchers to grasp the major trends or shifts in the material culture.

As we now looking into Micronesian islands, or southeast Asian sites for the ancestral cultural traits that later became important characteristics of Lapita cultural complex, it is inevitable that we need to test our hypothesis with multiple lines of evidence, to generate possible archaeological types that are sensitive enough to detect cultural transmission or change. “What defines Lapita motifs?” is a basic and important question that one should keep in mind while comparing different pottery traditions across the Pacific. It will be a dangerous move if one wants to define Lapita motifs solely based on its dentate-stamped decorative technique, and it is unwise to simply comparing a few geometric designs found across a vest area and deem them to be coming out of the same cultural tradition. By making this database a powerful tool of combining morphological, decorative, compositional, and technological attributes to generate archaeological types, and by making these data geo-referenced, it is my hope that this database will provide a solid foundation with standardized methods of recording data for further communications among archaeologists.

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Figure 1 Map showing the distribution of Lapita sites (outlined in dotted line) in the Pacific.
Figure 2: Dendrogram produced for motif analysis.
Figure 3: Dedrogram showing the classification system of published vessel forms

- Composite Vessel
- Maximum Diameter
- Height
- Maximum Diameter

Pot
- Carinate
- Restricted

Restrictive
- Round
- Maximum Width 10 - 20 cm
- Maximum Width 20 - 30 cm
- Maximum Width 30 - 40 cm
- Maximum Width 40 - 50 cm
- Maximum Width < 10 cm

Unrestricted
- Round
- Maximum Width 10 - 20 cm
- Maximum Width 20 - 30 cm
- Maximum Width 30 - 40 cm
- Maximum Width 40 - 50 cm
- Maximum Width < 10 cm
Figure 4 Motif Search page of the database
References


